

REMARKS

Applicant wishes to thank the Examiner for the careful consideration give to this case. The claims were improperly number in the original application and have been re-numbered. Claim 19 was duplicated in the original numbering sequence; claims number 1-109. No new matter has been added. The Examiner's restriction requirement groupings have been adjusted to reflect the changes in claim numbering.

The Examiner identified the following patentably distinct species of the claimed invention: Group I, marking material is a metal oxide, claims 4,5,27-56, 58, 59, 97; Group II marking material is a metal sulfide, claims 6, and 60; Group II marking material is a metal sulfate, claims 7 and 61; Group IV marking material is a metal cabonate, claims 8 and 62; Group V marking material is a glass frit, claims 16, 18, 66-85, 96; Group VI marking material is a mixed organic material, claims 19, 86-95, 98-105; Group VII marking material is Kaolin Clay, claims 9, 106-109.

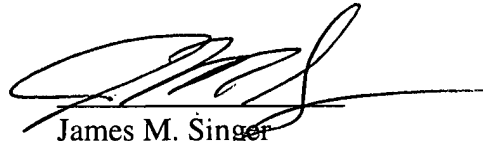
Applicant has elected species of the claimed invention of Group V for prosecution on the merits to which the claims shall be restricted, in the event that no generic claim is allowed. Applicant has also included an identification of all the claims readable on those in Group V which includes claims 1, 2, 3, 10-15, 16, 17, 18, 20-26, 66-85, and 96. No claims have been added to the application.

In view of the remarks made, transversing the restriction requirement, it is believed that the instant invention is in condition for examination and allowance on the merits, and notice to such effect is respectfully requested.

If the Examiner believes that additional issues need to be resolved, the undersigned invites the Examiner to contact him at the telephone number provided below.

The Commissioner is hereby authorized to charge any additional fees, or credit any overpayment to Deposit Account No. 50-0436

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VERSION WITH MARKINGS TO SHOW CHANGES MADE**IN THE CLAIMS**

The following shows how the numbering of the claims as they were originally filed have been changed.

1. A thermally activated, chemically based marking method comprising steps of:

electrostatically applying a layer of an energy absorbing marking material to a conductive or dielectric substrate to be marked; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite said energy absorbing material in accordance with the form of a marking to be applied, thereby forming a marking layer atop said substrate.
2. The method of claim 1, further comprising a step of providing a laminar air flow across said substrate during the irradiating step.
3. The method of claim 1, wherein said marking material comprises at least one metal compound.
4. The method of claim 3, wherein said metal compound is an oxide.
5. The method of claim 4, wherein said compound is a mixed metal oxide.
6. The method of claim 3, wherein said compound is a sulfide.
7. The method of claim 3, wherein said compound is a sulfate.
8. The method of claim 3, wherein said compound is a carbonate.
9. The method of claim 1, wherein said marking material comprises Kaolin clay.
10. The method of claim 1, wherein said marking material comprises an energy absorbing enhancer.
11. The method of claim 1, wherein said marking material comprises at least one colorant.
12. The method of claim 10 wherein said energy absorbing enhancer comprises carbon black.
13. The method of claim 1, wherein said substrate comprises materials selected from the group consisting of metals, glasses, ceramics and plastics.
14. The method of claim 13, wherein said substrate comprises at least one metal.

15. The method of claim 13, wherein said substrate comprises at least one glass.
16. The method of claim 1, wherein said marking material comprises at least one glass frit material.
17. The method of claim 16, wherein said glass frit material comprises at least one oxide selected from oxides of alkali metals, alkaline earth metals, silicon, boron and transition metals,
18. The method of claim 1, wherein said marking material comprises at least one glass frit material and at least one metal compound.
19. The method of claim 11, wherein said marking material comprises at least one organic pigment.
- [19]20. The method of claim 1, wherein said marking material is applied by direct electrostatic coating of a conductive substrate.
- [20]21. The method of claim 1, wherein said marking material is applied by direct electrostatic coating of a dielectric substrate, after said substrate has been coated with a layer of conductive material.
- [21]22. The method of claim 1, wherein said marking material is applied as dry particles.
- [22]23. The method of claim 1, wherein said marking material is applied as liquid droplets.
- [23]24. The method of claim 1, wherein said marking material is electrostatically applied in the form of a marking to be applied to said substrate.
- [24]25. The method of claim 1 wherein said radiant energy beam is produced by a laser, diode laser or diode-pumped laser.
- [25]26. A substrate as marked by the method of claim 1.
- [26]27. A thermally activated, chemically based marking method comprising steps of:

electrostatically applying a layer of mixed metal oxide material containing an energy absorbing enhancer to a metal substrate; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the metal oxide material and/or said energy absorbing enhancer in accordance with the form of a marking to be applied, thereby forming a marking layer atop the substrate.
- [27]28. The method of claim [26]27 further comprising the step of providing a laminar air flow across the substrate during the irradiating step.

- [28]29. The method of claim [26]27, wherein the mixed metal oxide material comprises at least one colorant, and the energy absorbing enhancer comprises carbon black.
- [29]30. The method of claim [26]27, wherein the radiant energy beam comprises a laser beam having an energy level ranging between 1 and 30 watts, a spot size ranging between 5 and 200 microns, and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [30]31. The method of claim [26]27, wherein the layer of mixed metal oxide material has a thickness ranging between 5 and 500 microns.
- [31]32. The method of claim [26]27 wherein said irradiating step is started at a room temperature of about 70° F.
- [32]33. A metal substrate as marked by the process according to claim [26]27.
- [33]34. A thermally activated chemically based marking method comprising steps of:
- electrostatically applying a layer of mixed metal oxide material containing an energy absorbing enhancer to a substrate selected from the group consisting of aluminum, brass, chrome, copper, nickel, steel, stainless steel, tin, glass, ceramics, porcelain, and plastics; and
- irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer in accordance with the form of a marking to be applied, thereby forming a marking layer atop the substrate.
- [34]35. The method of claim [33]34 further comprising the step of providing a laminar air flow across the substrate during the irradiating step.
- [35]36. The method of claim [33]34, wherein said mixed oxide material is applied as dry particles.
- [36]37. The method of claim [33]34, wherein said mixed oxide material is applied as liquid droplets.
- [37]38. The method of claim [33]34, wherein the energy absorbing enhancer comprises carbon black.
- [38]39. The method of claim [33]34, wherein the radiant energy beam comprises a laser beam having an energy level ranging between 1 and 30 watts, a spot size ranging between 5 and 200 microns, and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [39]40. The method of claim [33]34, wherein the layer of mixed metal oxide material has a thickness ranging between 5 and 500 microns.

- [40]41. The method of claim [33]34 wherein said irradiating step is started at a room temperature of about 70° F.
- [41]42. The method of claim [33]34, wherein the mixed metal oxide material comprises a colorant.
- [42]43. A substrate material as laser marked by the process according to claim [33]34.
- [43]44. A thermally activated, chemically based marking method comprising steps of:
- electrostatically applying a layer of mixed metal oxide material containing an energy absorbing enhancer to a substrate to be marked in the form of a marking to be applied; and
- irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer, thereby forming a marking layer atop the substrate.
- [44]45. The method of claim [43]44, further comprising the step of providing a laminar air flow across the substrate during the irradiating step.
- [45]46. The method of claim [43]44, wherein said mixed metal oxide material is applied as dry particles.
- [46]47. The method of claim [43]44, wherein said mixed metal oxide material is applied as liquid droplets.
- [47]48. The method of claim [43]44, wherein the energy absorbing enhancer comprises carbon black.
- [48]49. The method of claim [43]44, wherein the radiant energy beam comprises a laser beam having an energy level ranging between 1 and 30 watts and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [49]50. The method of claim [43]44, wherein the layer of metal oxide material has a thickness ranging between 5 and 500 microns.
- [50]51. The method of claim [43]44, wherein the irradiating step is started at a room temperature of about 70° F.
- [51]52. The method of claim [43]44, wherein the mixed metal oxide material comprises a colorant.
- [52]53. A substrate material as marked by the process according to claim [43]44.
- [53]54. A thermally activated chemically based marking method comprising steps of:
- electrostatically applying a layer having a metal oxide component and comprising an energy absorbing enhancing component to a metal substrate; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancing component, thereby forming an adhered marking layer atop the substrate.

[54]55. A thermally activated, chemically based marking method comprising steps of:

electrostatically applying a layer having a mixed metal oxide component and an energy absorbing enhancing component to a substrate selected from the group consisting of aluminum, brass, chrome, copper, nickel, steel, tin, glass, ceramics, and plastics; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancing component, thereby forming an adhered marking layer atop the substrate.

[55]56. A thermally activated chemically based marking method comprising steps of:

electrostatically applying a material containing at least one metal oxide comprising an energy absorbing enhancing component to a substrate to be marked in the form of a marking to be applied; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancing component, thereby forming a marking layer atop the substrate.

[56]57. A thermally activated chemically based marking method comprising steps of:

electrostatically applying a layer of a marking material comprising at least one metal compound to a markable substrate comprising at least one material selected from the group consisting of metals, glasses, ceramics and plastics; and

irradiating said layer with a radiant energy beam having a wavelength selected to be absorbed by said marking material, thereby forming a bonded marking layer atop the substrate.

[57]58. The method of claim [56]57, wherein said metal compound comprises a metal oxide.

[58]59. The method of claim [57]58, wherein said metal compound is a mixed metal oxide.

[59]60. The method of claim [56]57, wherein said metal compound is a sulfide.

[60]61. The method of claim [56]57, wherein said metal compound is a sulfate.

[61]62. The method of claim [56]57, wherein said metal compound is a carbonate.

- [62]63. The method of claim [56]57, wherein said marking material further comprises at least one energy absorbing enhancing component.
- [63]64. The method of claim [56]57, wherein said marking material comprises at least one colorant or pigment.
- [64]65. The method of claim [63]64, wherein said marking material comprises at least one organic pigment.
- [65]66. A thermally activated chemically based marking method comprising the steps of:
- electrostatically applying a layer of glass frit material containing an energy absorbing enhancer to a glass substrate; and
- irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer in accordance with the form of a marking to be applied, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate; and
- wherein the layer of glass frit material has a thickness ranging between 5 and 500 microns.
- [66]67. The method of claim [65]66, further comprising the step of providing a laminar air flow across the substrate during the irradiating step.
- [67]68. The method of claim [65]66, wherein said glass frit material is applied as dry particles.
- [68]69. The method of claim [65]66, wherein said glass frit material is applied as liquid droplets.
- [69]70. The method of claim [65]66, wherein the glass frit material further comprises a borosilicate glass and the energy absorbing enhancer comprises carbon black.
- [70]71. The method of claim [65]66, wherein the radiant energy beam comprises a laser beam having an energy level ranging between 1 and 30 watts, a spot size ranging between 5 and 200 microns, and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [71]72. The method of claim [65]66, wherein said irradiating step is started at a room temperature of about 70 F.
- [72]73. The method of claim [65]66, wherein the glass frit material further comprises a colorant.
- [73]74. The method of claim [72]73, wherein said colorant comprises at least one organic pigment.

- [74]75. A glass material as marked by the process according to claim [65]66.
- [75]76. A thermally activated, chemically based marking method comprising the steps of:
electrostatically applying a layer of glass frit material containing an energy absorbing enhancer to a metal substrate; and
irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer in accordance with the form of a marking to be applied, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate; and
wherein the layer of glass frit material has a thickness ranging between 5 and 500 microns.
- [76]77. The method of claim [75]76 further comprising the step of providing a laminar air flow across the substrate during the irradiating step.
- [77]78. The method of claim [75]76, wherein the glass frit material comprises a borosilicate glass, and the energy absorbing enhancer comprises carbon black.
- [78]79. The method of claim [75]76, wherein the radiant energy beam comprises a laser having an energy level between 1 and 30 watts, a spot size ranging between 5 and 200 microns, and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [79]80. The method of claim [75]76 wherein said irradiating step is started at a room temperature of about 70° F.
- [80]81. The method of claim [75]76, wherein said glass frit material is applied as dry particles.
- [81]82. The method of claim [75]76, wherein said glass frit material is applied as liquid droplets.
- [82]83. The method of claim [75]76, wherein the glass frit material further comprises a colorant.
- [83]84. A metal substrate as marked by the process according to claim [75]76.
- [84]85. A thermally activated chemically based marking method comprising the steps of;
electrostatically applying a layer of glass frit material containing an energy absorbing enhancer to a substrate selected from the group consisting of glass, ceramic, porcelain, aluminum, brass, steel, stainless steel and tin; and
irradiating said layer with a beam having a wavelength selected to excite the energy absorbing enhancer in accordance with the form a marking to be applied,

thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate.

- [85]86. A thermally activated, chemically based marking method Comprising the steps of:
- electrostatically applying a layer of marking material comprising at least one of a mixed organic pigment material and an energy absorbing enhancer to a plastic substrate; and
- irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer in accordance with the form of a marking to be applied, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate.
- [86]87. The method of claim [85]86, further comprising the step of providing a laminar air flow across the substrate during the irradiating step.
- [87]88. The method of claim [85]86, wherein said organic pigment material comprises carbon black.
- [88]89. The method of claim [85]86, wherein the energy absorbing enhancer comprises carbon black.
- [89]90. The method of claim [85]86, wherein the radiant energy beam comprises a laser beam having an energy level ranging between 1 and 30 watts, a spot size ranging between 5 and 200 microns, and a marking speed along the substrate ranging between 25 and 1000mm/sec.
- [90]91. The method of claim [85]86, wherein the layer of mixed organic pigment material has a thickness ranging between 5 and 500 microns,
- [91]92. The method of claim [85]86 wherein said irradiating step is started at a room temperature of about 70° F.
- [92]93. The method of claim [85]86, wherein said organic pigment material is applied as dry particles.
- [93]94. The method of claim [85]86, wherein said organic pigment material is applied as liquid droplets.
- [94]95. A plastic substrate material as marked by the process according to claim [85]86.
- [95]96. A thermally activated chemically based marking method comprising the steps of:
- electrostatically applying a layer of glass frit material optionally containing an energy absorbing enhancer to a substrate to be marked in the form of a marking to be applied; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the glass frit material and/or said energy absorbing enhancer, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate.

[96]97. A thermally activated chemically based marking method comprising the steps of:

electrostatically applying a layer of mixed metal oxide material containing an energy absorbing enhancer to a substrate to be marked in the form of a marking to be applied; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate.

[97]98. A thermally activated chemically based marking method comprising the steps of:

electrostatically applying a layer of mixed organic pigment material containing an energy absorbing enhancer to a substrate to be marked in the form of a marking to be applied; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite the energy absorbing enhancer, thereby forming a bonded and permanent marking layer atop the substrate which is visible in contrast with the substrate.

[98]99. The method of claim [97]98, further comprising the step of providing a laminar air flow across the substrate during the irradiating step.

[99]100. The method of claim [97]98, wherein the radiant energy beam further comprises a laser beam having an energy level ranging between 1 and 30 watts and a marking speed along the substrate ranging between 25 and 1000mm/sec.

[100]101. The method of claim [97]98, wherein said irradiating step is started at a room temperature of about 70° F.

[101]102. The method of claim [97]98, wherein said organic pigment material is applied as dry particles.

[102]103. The method of claim [97]98, wherein said organic pigment material is applied as liquid droplets.

[103]104. The method of claim [97]98, wherein the layer of mixed organic pigment material has a thickness ranging between 5 and 500 microns.

[104]105. A substrate as marked by the process according to claim [97]98.

[105]106. A thermally activated, chemically based marking method comprising steps of:

electrostatically applying a layer of a marking material comprising a Kaolin clay to a substrate to be marked; and

irradiating said layer with a radiant energy beam having a wavelength selected to excite at least said Kaolin clay in accordance with the form of a marking to be applied, thereby forming a marking layer atop said substrate.

[106]107. The method of claim [105]106, wherein said marking material further comprises an energy absorbing enhancer.

[107]108. The method of claim [105]106, wherein said marking material is applied as dry particles.

[108]109. The method of claim [105]106, wherein said marking material is applied as liquid droplets.